Saimaa University of Applied Sciences
Faculty of Technology, Lappeenranta
Double Degree Programme in Civil and Construction Engineering
Civil Engineering

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Green buildings in Russia, environmental classification of buildings

Bachelor's Thesis 2016

Abstract

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The aim of this thesis was to investigate and identify what part green construction takes in the world’s construction industry and what green construction standards exist. This topic is actual, as all community is interested in rational use of non-renewable recourses. What is more the objective of the study was collection of information about certification systems all over the world such as BREEAM, LEED, DGNB and their criteria and implementation of green standards in Russian real estate market, due to local norms and national certification system Green Zoom. The main advantages and benefits of buildings certification for developers, ordinary people and environment were considered.

The data was collected from special and technical literature, normative acts, and the project which was developed and implemented in Saint-Petersburg by Akruks-PRO, the company designs and installs engineering services.

The results of the study show that the introduction of green technologies is not a complicated process, as it is perceived by developers, especially in Russia, but as a result it brings great benefit and advantages. Based on the findings it could be said that green construction is on the way of development and in future the number of certificated building in Russia and all over the world will increase.

Keywords: Breeam, Leed, Green Zoom, Green Buildings, Building Certifications.

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1 Introduction

Nowadays world community is interested in sustainable development and rational use of natural resources.

The aim of green building is to reduce consumption of energy and material resources throughout the building life cycle. Comfort living in harmony with environment in conditions of non-renewable resources has long been a principle followed by the US, Europe, UAE, China and several other countries. Most rapidly ecological construction is being implemented by Europe. According to statistic, 44% of developers perform more than 60% of their projects according to the principles of sustainable construction, and this number is growing every year.

During the last 10-20 years to provide efficient consumption of natural resources and minimize environmental pollution the latest technologies are used. Such as solar panels, wind turbines, water recycling systems, sensors and motion lighting, glass facades and many other innovations.

As for Russia, the process of implementing the principles of eco-sustainable design and construction meets the great difficulties. The market is not used to care about the environment and that is why distrust green initiatives. There are should be companies that would make such projects common to Russia, but at the moment the number of green buildings is very low.

On the other hand, some positive trends should be noted. Many companies have changed their position. What is more there have been some changes in legislation - a law on energy conservation was issued. The interest to green projects has increased at the state level. The push toward development and implementation increased during the preparation for the Olympics in Sochi (Decree of the RF Government of 17.11.2008 number 1662-P).

Mainly in the Russian Federation buildings are certified under international standards LEED and BREEAM, but in September 8, 2014 Russian system called GREEN ZOOM was approved and launched. As of January 2016, 15 construction projects at Russia received a certificate of GREEN ZOOM (the national agency of sustainable development 2016).

2 Types of certification of environmental construction

2.1 History of the creation of standards and certification systems

The first standard was launched in 1990 by the British company Building Research Establishment (BRE) it was BREEAM (BRE Environmental Assessment Method). Nowadays it is the most popular certification standard which counts more than 110 000 projects.

Then, in France, Canada, Hong Kong, Taiwan and the United States appeared LEED (Leadership in Energy and Environmental Design), which was developed by the United States Green Building Council in 1998. Further there were two ways of local certification development. The first was to take BREEAM or LEED base with determining boundary values in accordance with national legislation and strategic documents, and the second way was to develop a local national standard.

Here are 55 national systems of standards in 33 countries:

1. Australia: Nabers, Green Star;
2. Brazil: AQUA, LEED Brazil;
3. United Kingdom: BREEAM;
4. Vietnam: LOTUS Rating tools;
5. Germany: DGNB, CEPHEUS;
6. Hong Kong: HK BEAM;
7. India: Indian GBC, Green Building Construction India, GRIHA;
8. Indonesia: GBC Indonesia, Greenship;
9. Spain: VERDE;
10. Italy: Protocollo Itaca, GBC Italia;
11. Canada: LEED Canada, Green Globes, Built Green Canada;
12. China: GBAS;
13. Republic of Korea: Green Building Certification Criteria, Korea GBC;

14. Malaysia: GBI Malaysia;
15. Mexico: LEED Mexico;
16. Netherlands: BREEAM Netherlands;
17. New Zealand: Green Star NZ;
18. United Arab Emirates: Estidama;
19. Pakistan: Pakistan GBC;
20. Portugal: Lider A, SBToolPT;
21. Singapore: Green Mark;
22. US: LEED, Living Building Challenge, Green Globes, Built it Green, NAHB NGBC, International Green Construction Code, ENERGY STAR;
23. Thailand: TREES;
24. Taiwan: Green Building Label;
25. Turkey: Yesilibina;
26. Philippines: BERDE, Philippine GBC;
27. Finland: PromisE;
28. France: HQE;
29. Czech Republic: SBToolCZ;
30. Switzerland: Minergie;
31. South Africa: Green Star SA;
32. Japan: CASBEE;
33. Russian Federation: Green Building Council (SPZS), Environmental Certification Center – Green standards NOSTROY, GOST R 54964-2012, Green Zoom.

2.2 The principles of sustainable construction

Currently in particular construction industry is faced with the growing threat of global climate change, the depletion of natural resources and the collapse of the global ecosystem. The fact is that the buildings all around the world use about 40% of the primary energy consumption, 67% of all electricity, 40% of the raw material and 14% of all drinking water supplies, as well as produce 35% of carbon dioxide and almost half of the solid waste (Russia 2014. Statistical Handbook).

Regarding that fact, the aims of green or ecological construction are to reduce the harmful effects of construction activities on human health and the environment appeared on the global level.

Ecological construction (green building) is the practice of the construction and operation of buildings, the objectives of which are to reduce the consumption of energy and material resources throughout the life cycle of the building, the maintenance or improvement of the quality of buildings and the comfort of their indoor environment.

The main components of ecological building are environmental materials. Eco-friendly materials are safe for humans. It means that during the operation they do not emit harmful volatile substances, do not contain toxic or carcinogenic compounds, and are safe for the environment at the stages of their production, use and disposal, i.e. throughout the life cycle.

Green building is the result of project design focused on:

- Efficient use of scarce resources (land, energy, heat and cold, water and materials);
- Reduction of harmful effects on human health;
- Minimize negative environmental impact throughout the entire lifecycle of the building, through a better location, design, construction, management, operation and subsequent demolition.

On the basis of the above the following tasks of ecological construction could be distinguished:

- Reducing the harmful effects of construction activities on human health and the environment what can be achieved through the application of new technologies and approaches;
- The creation of new industrial products;
- Reducing the load on the regional energy network and improving the reliability of their work;
- Creation of new workplaces in the field of intellectual production;
- Reducing the cost of maintenance of buildings of new construction.

It is important to add that the certification is voluntary, which means that the government does not oblige to issue this type of certificate. However, the passage of environmental certification, can positively affect product or service.

2.3 Advantages of certified buildings

Benefits of buildings and products certification in accordance with green standards for investors, property owners, developers, designers and managers of companies are the following:

- Competitiveness in project promotion;
- Guaranty that during the construction technologies relevant to principles of sustainable development were used;
- Boost to search for innovative solutions that minimize the impact on the environment;
- Lower operating costs and improving of working and living environment quality;
- Company get a right to be called Green Company in the real estate sector if the project complies with the standard.

2.4 Factors increasing the investment appeal of objects of green building

Certification in accordance to the green construction standards allows not only get independent evaluation, but also rise the investment attractiveness of the building. Generally investors may forecast the increase of the net operating income by 5,9 % (Guseva 2012),because of the following:

- Increase the rental rates at 2-16%;
- Increase the occupancy rates at 2-16%;
- Reduction of operating expenses by 25-30% due to the reduction of energy consumption;
- Increase the value of the sales to 5,8-35%;
- Improving staff efficiency by 1% for leed "certified" and "silver" and 1.5% for the "gold" and "platinum" certification;
- Attracting and retaining of tenants.

2.5 Marketing advantage certification object

The main marketing benefit is that certificated buildings have an advantage over traditional buildings, as they are more attractive for customers. That forms additional cost growth for developer.

Marketing advantage certification object:

- The novelty and originality of the proposal;
- Proof of the object quality for the international community and the renters;
- Involving tenants which corporate culture include environmental responsibility;
- Certification results can be used as a basis for an advertising campaign;
- Achieving baseline standards increases the building cost by 2-3%, higher levels - 5-7.5% (Guseva 2012).

2.6 Advantages for the environment

One of the basic principles of green building is to minimize the negative impact on the environment. Thus certified building unlike traditional have the following major environmental advantages:

- A significant reduction in greenhouse gas emissions, waste and polluted water;
- Conservation of natural resources;
- Expansion and protection of natural habitats.

2.7 Benefits to health and society

Another aim of green building is to maintain or improve the quality of buildings and the comfort of their indoor environment. This practice introduce economy, utility, durability and comfort to the classical building design concepts.

Although new technology for the construction of green buildings are constantly being improved, the main aim of this idea is to reduce the influence of present construction on human health, that could be achieved by:

- Creation of a comfortable environment considering indoor air quality, as well as thermal and acoustic performance;
- Reduction of pollution of the water, soil and air, and as a result, reducing the load on the urban infrastructure;
- Life quality improving by using the best urban design.

Thus, the development and implementation of green building standards encourage business development, innovation and the economy, improve the quality of life of the society and the environment. In addition, they are a tool for a reasonable economy, as they keep the money at all stages, promote integration into the global movement, enable foreign investment and recognition on a global level.

3 Leading rating systems of buildings environmental certification in Russia

3.1 The British system of environmental certification BREEAM

BREEAM can be used to assess the environmental performance of existing buildings undergoing major refurbishments (including new build extensions) such as houses, offices, factories, leisure centres, prisons, retail facilities, hospitals and schools.

3.1.1 Scope of BREEAM

The system is used for both new and operated facilities for following purposes: educational institutions, courts, industrial facilities, health care facilities, office buildings, shopping areas, prisons, housing, apartment buildings, modernization and improvement of environmental efficiency of the existing building stock, reconstruction of existing housing stock, socio-territorial units with integrated conditions for work, study, living and entertainment, other types of buildings and structures (development of individual schemes).

3.1.2 BREEAM requirements

In general, the rating method is founded on the assessment of the following categories: energy, management, health and wellbeing, pollution, materials, land use and ecology, transport, waste and water.

Energy category focuses on the measures taken to minimise CO2 emissions, such as the use of low or zero carbon technologies, and building fabric performance, among others;

Management refers to the construction management, commissioning, the professionals involved, the impact on construction site, the life cycle costing, etc.

Health and wellbeing criteria refers to a number of issues related to the comfort and health of the occupants, and the quality of the spaces in terms of daylighting, ventilation, thermal comfort and zoning, acoustic performance, etc.

Pollution criteria evaluates the building’s performance in terms of reducing risks of pollution from refrigerants, heating sources, and light and noise pollution;

The use of construction materials with a low environmental impact throughout the entire lifecycle of the building; reuse of materials; a certified source of materials; protection of exposed parts of buildings and landscapes;

Land use and ecology category analyses the impact of the building in terms of contamination, ecology of the site, and, in the long term, biodiversity of the site;

Transport criteria focuses on connectivity issues, such as proximity to public transport and cycling facilities;

Waste category refers to the waste management during the construction stage and during occupancy;

Water criteria refers to water management, consumption and recycling.

Environmental weightings are applied to each category (Chart 1).

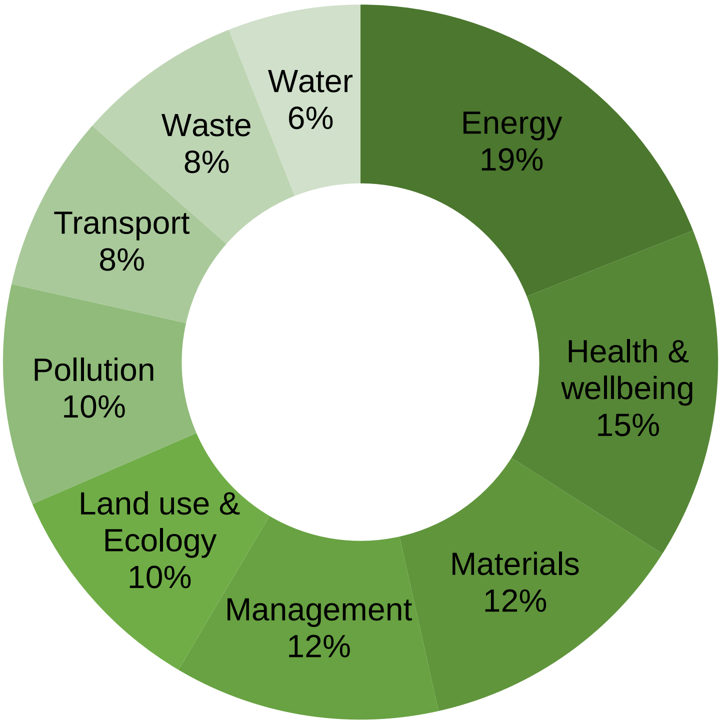

Chart 1. BREEAM categories and weightings

The object gets accreditation due to the total score according to BREEAM rating (Table 1).

Table 1. BREEAM rating

BREEAM Rating	% score
Outstanding	≥85
Excellent	≥70
Very good	≥55
Good	≥45
Pass	≥30
Unclassified	<30

To sum up, BREEAM certification is a universal method for valuation of real estate sustainability, both in Europe and beyond. In addition, the BREEAM is relevant for many different buildings: office, residential, industrial, commercial, public, and even prisons. It performs as the basis for many other "green" standards, spread throughout the world. The system includes a number of simple criteria that must be met during construction and operation of the facility.

3.1.3 BREEAM rating procedure

BREEAM standard is defined as an independent audit of project documents, making a report for certification authority and BRE Global – Customer interaction (Figure 1). Independency and rating validity is proved by Quality Assurance process by BRE Global.

The BREEAM certification process starts with preliminary consulting which is executed by BREEAM in-house specialist. As seen on Figure 1, 12 rating systems are proposed and there is an “individual” approach for objects not fitting in any of the plans listed.

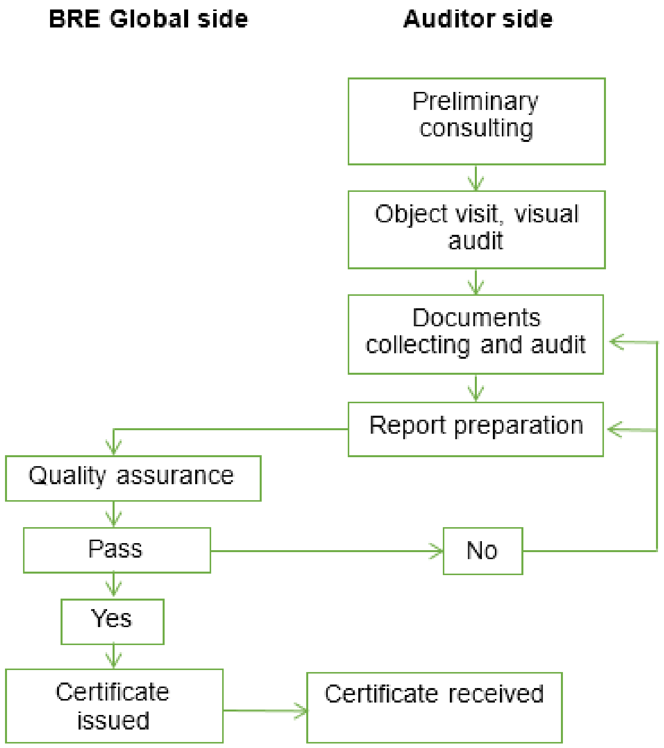

Figure 1. BREEAM rating process scheme

After the correct process stream is approved, key building parameters should be formulated, including certification rank, updated processes, addition of alternative energy sources and so on.

There is a set of criteria (100-110) looking at which a client designs a strategy of gaining the wanted ecology level. In most cases for commercial developers the main factors of attending certification routine are reputation, creating of extra concurrent advantages and an upgrade of project capitalization. The desired rating value is decided at the initial project design step which provides the maximum output with the minimum investment capital input.

There are five ranks of certification success: Pass (30%), Good (45%), Very Good (55%), Excellent (70%) and Outstanding (85%). More and more additional requirements must be achieved in order to make each step up in the hierarchy. Outstanding rank also requires object’s information to be published by BRE as an example.

The cost of BREEAM certification is made up of three components: the cost of contributions to the certification body - BRE Global (from about 3 500 to 16 500 EUR), the value of the appraiser consulting services - varies from project to project, the scope of provided consulting services (from 5 500 to 110 000 EUR) and the cost of the "greening" of the project (Molkhanova 2012). The cost of "greening" will depend on a number of factors such as the timeliness of decision making on the certification, rating and planned construction level of the organization.

3.1.4 BREAM in Russian Federation

The first building in Russia certified under the BREEAM standard is the office complex DUCAT PLACE III (Figure 3) in Moscow.

Certified in 2010.
Standard: BREEAM.
Level: Very Good.
The operation company and developer: Hines.
Assessor: Mott MacDonald, Ltd.

Figure 2. DUCAT PLACE III

Design: London branch of Skidmore, Owings & Merrill.

Ducat Place III is a 14 floor business center situated on Gashek street in Moscow.

Here is the list of green technologies used on this project:

1. Energy-efficient lighting. Conventional lamps in the office center are replaced by energy efficient. Special application was designed to operate the light systems, taking into account the time of day;
2. Motion sensors. Motion sensors were installed in bathrooms;
3. Optimized elevators and air condition systems which reduce building energy consumption by 35%;
4. Separate waste collection. The operating company has organized systematic waste management by signing contracts with private contractors for the processing of paper, cardboard, plastic, metal, glass, light bulbs, ink cartridges and batteries;
5. Bicycle parking;
6. Bulk car park. The project has the highest ratio of space and parking spaces for the center of Moscow;
7. Quality views.

On the basis of intra-Hines GO (operation company) Green Office program for the tenants was developed in order to promote the economical use of resources. Due to the environmental initiatives of the developer the building’s power consumption decreased by almost 35% in 2010, compared with 2008, while the savings for tenants accounted more than 188,000 dollars per year.

The second building in Russia, registered under the standard BREEAM, is the Japanese House in Moscow (Figure 3). The building has earned a rating Good.

Figure 3. Japanese House

Certified in 2012

Standard: BREEAM In-Use.

Level: Good.

The management company and the developer CJSC "Savvinskaya Seye".

Assessor: NAI Becar.

Total area: 14 000 m2.

General Contractor: Skanska.

Japanese house is situated on Savvinskaya embankment. This is the business center class "A" with the two-level underground parking and a conference center.

The realization of this project was the first example of Japanese investments in Moscow real estate market. Besides, Japanese house is a cultural center with Japanese art language courses, which makes it more attractive to tenants.

Here is the list of green technologies used on this project:

1. Water re-use. Wastewater treatment systems and devices with recycling of industrial water;
2. Automatic lighting control in technical areas and in the parking;
3. Modern insulation;
4. Water and energy consumption meters;
5. Environmental management. Every year the operation company analyzes the resource consumption to create a year plan to reduce energy and water consumption and waste disposal;
6. Comfortable environment. There is a courtyard, a café and a greenhouse for flowers and fruits on the roof.

The operating company Savvinskaya-Seye is very proud of Japanese house becoming the first office center in Russia that is certified by BREEAM In-Use. Since its inception the company follows the 3R principle-reduce, reuse and recycle.

The residential complex Swedish Krona (Figure 4) was one of the first objects in Saint-Petersburg that was certificated by BREEAM.

Certified in 2015.
Standard: BREEAM International Bespoke.
Level: Very Good.
Developer: NCC Real Estate.
Total area: 35 702 $м^2$.
Total area of residential buildings: 8 344,2 м2.

Swedish developer NCC is one of the leading company in Saint-Petersburg at real estate market. That status was reached because of implementation of modern construction technologies, high construction quality, commissioning on time and customer focus.

Figure 4. Swedish Krona residential complex

At 2016 NCC Real Estate separated from NCC group and became Bonava.

Technical equipment of buildings performs the quality of the object: a modern system of water filtration, mechanical air ventilation, silent elevators.

The use of energy-saving technologies has reduced power consumption by 25%. The heat recovery system helps to reduce the heat consumption by 80% during the cold season.

What is more BREEAM International Bespoke certificate confirm the project quality at the following: safe construction site. 0% of soil and environment pollution during the construction. The use of material according to the BREEAM. The developed transport infrastructure (transport variety and pedestrian access). Surrounding public areas: shops, kindergarten, schools, pharmacy and etc. Energy efficiency apartment recuperation, impulse meters, energy saving lifts, common control room. Organization of internal space: bicycle and pram storage. Customer manuals for apartment operation.

Project Swedish krona has several awards connected with green construction. At 2010 it got the status of the most energy efficient object in Russia at the eco-development sphere. Moreover, at 2012 it got the Green Awards as real estate object.

3.2 American ecological certification system LEED

The next well known and popular among international voluntary certification systems as BREEAM is LEED standard. The Leadership in Energy and Environmental Design (LEED) is a rating-type green construction objects assessment system. It was developed by USA Green Building Council (USGBC) in 1993.

More than 7.1 billion square meters are certified according to LEED: 5462 commercial structures and 5 988 private buildings (with more than 27 000 commercial and more than 24 000 privately owned objects waiting for their certificates) (Polyakov 2016).

LEED is an outcome of the new business philosophy, which sees the evolution of society in achieving balance between satisfaction of needs of the current generation and opportunities for next generations to reach such a standard of living.

LEED can be effectively applied both for business and private structures. The system includes evaluation of all possible project implementation steps - design, construction, finishing, tenant selection and final modifications.

Territory exploitation and development parameter certified by LEED helps analyze how environment around the building is affected by them.

The standard may be applied for construction of a new building, maintenance of finished structures, finishing of a construction object, schools, commercial sites (business centers), trading and shopping areas, healthcare infrastructure facilities, residential real estate and development of countryside cottages.

The latest 4th version of the LEED standard was released in 2014. It consists of 8 blocks: location and transportation, sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environment quality, innovation and regional priority.

These blocks contain various lists of requirements is a final mark for a project comes as a sum of all points that project scores in all blocks together. A facility earns LEED certificate only if it suits some certain necessary conditions stated below. For instance, some environment protection complex must be operated in order to generate a barrier for different hazardous matter.

LEED standard requirements sections are consist of: location and transportation, sustainable sites, water efficiency, energy and atmosphere, materials and resources, indoor environment quality, innovation and regional priority.

Location and transportation category includes transport accessibility, availability of eco-cars and bicycle infrastructure.

Soil erosion control and excessive precipitation control are requirements in the sustainable sites criteria. Some extra points may be granted for: choosing ecologically sustainable areas for construction sites; for lowering the amount of built up areas (for recently founded objects); for managing rain water flow stream; for decreasing a number of asphalt-covered territories within the project and for reducing electric light exposure effect on the current and nearby zones.

Water efficiency criteria includes cutting down both external and internal water consumption.

Energy and atmosphere category includes getting rid of hydrochloric cooling agents in cooling systems and fulfilling basic requirements of energy saving regulation ASHRAE 90.1-2004.

Materials and resources criteria refers collection, storing and transportation of reusable material. Use of any of the following resources attracts extra LEED rating points to the project: construction waste; quickly replenishing raw material (e.g. bamboo); local material produced close to the facility location; recycled material or certified wood.

Indoor environment quality category consists of keeping up with tobacco smoking regulations and indoor air ventilation regulations. Such add-ons as: increasing of air ventilation; maintaining proper air quality during construction work; utilizing low harmful additives content and low glue content materials; watching chemical and hazardous atmosphere emissions; maintaining heat comfort parameters – improving heating, air conditioning and ventilation sub-systems automation; getting more use of natural light.

Innovation. Certification committee values an exceptional execution and exceeding of basic LEED expectations of the project and general innovative approach which usually is not measured in previous categories. A single extra point may be given in case that one of the main project group members is LEED Accredited Professional.

Maximum four points may be gathered from region’s authorities or USGBC board in regional priority category.

The whole procedure is designed in such a way that no certificate is issued if at least one requirement is missing or not thought through well enough.

The final certificate is defined by the sum of all points from blocks 1-8 and has few measures of success.

It is important to remember that LEED does not replace any formal state regulation and requirement (GOST’s and SNiP’s in Russia. Their main purpose is to guarantee minimal essential level of people’s safety). The system may only complement it by complete modern quality assurance methods.

It is optionally possible to gain a few extra points by keeping in mind regional features. Each category from the list is checked from the view of relative importance of category’s impact on ranking object. A certain rank and certificate type (Table 2) is announced depending on the amount of points. There are four types of certificates – certified (basic), silver, gold and platinum.

Table 2. LEED rating.

LEED rating	Final result, points
CERTIFIED	40-49
SILVER	50-59
GOLD	60-79
PLATINUM	≥80

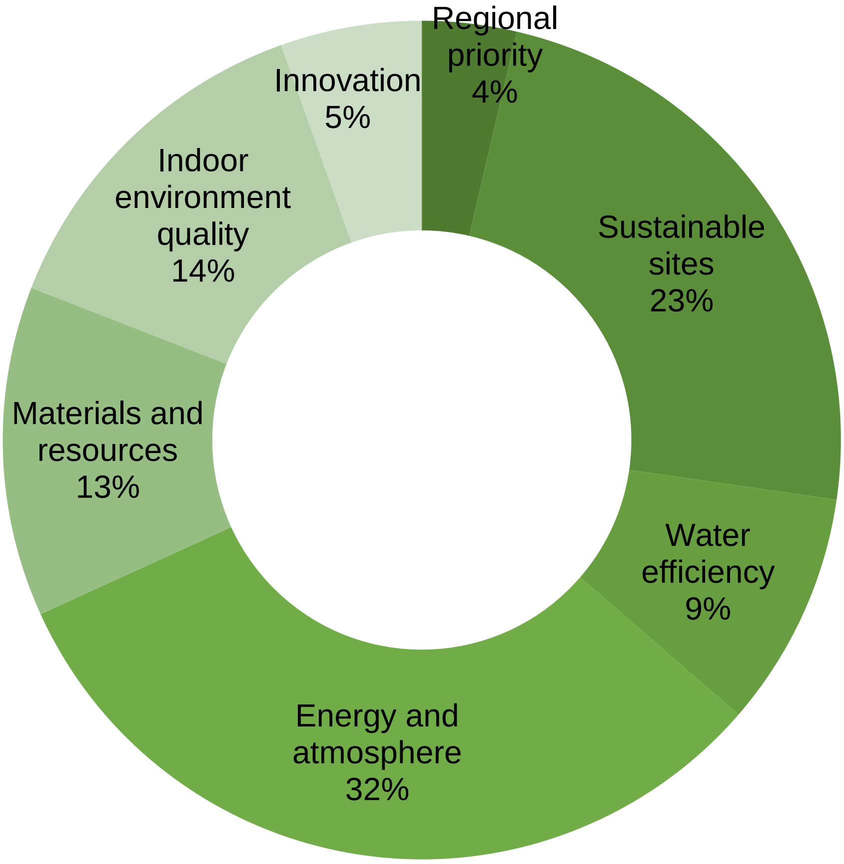

Chart 2. LEED categories and their influence on total score

The diagram clearly demonstrates the most important parts of the standard. Moreover, this new approach allows us to solve problems like:

1. Decrease in energy and material resources consumption of a building;
2. Decrease in harmful effect on nature eco-systems;
3. Provision of steady comfort level of human habitat;
4. Creation of new energy efficient and energy saving products as well as new jobs in production and maintenance sectors;
5. Shaping community’s need of modern knowledge and technology in the field of renewable energy.

In most cases LEED certification is applied on projects awaiting foreign investments or on construction of high class real estate. A valid certificate automatically makes an investment target more attractive for investing by increasing developer's credibility and by being a kind of guarantee of return of investment.

Russian investors should keep an eye on LEED mostly because of end-to-end responsibility for validity of decisions and future project functions it brings to designers.

3.2.1 LEED in Russian Federation

The first ever episode of gaining a certificate in Russia happened in Tver region with Swedish SKF concern's railroad bearings production site.

Figure 5. SKF factory

Owner: SKF concern.
General designer: AECOM Company.
Standard: LEED.
Rating: Gold.
Location: Tver.
Area: the first phase 9700 m^2, second phase — 15 000 m^2.
Additional green technology investments — 7 % of the total project's expenses.

Swedish SKF concern's railroad bearings production plant in Borolevo-2 industrial area of Tver region became the first building in Russia certified by international green standard.

Some green technology concepts used there:

1. Heat utilization. Energy efficient chillers are used in the system which prepares technical cold water. As a result by-process dispersing heat is utilized as building heating solution;
2. Automated engineering system control node. It lets perform detailed analysis of energy consumption;
3. Natural light. 90% of total site's area is illuminated by natural light in day-time;
4. On-demand ventilation. Maintains optimal work environment and energy efficiency;
5. CO2 level monitoring systems;
6. Water reuse. Innovative process of vacuum water distillation is introduced – 100% water reuse rate when phosphating is done. Only rainwater is used for lawn irrigation.

3.2.2 LEED rating procedure

In contrast to the role of the appraiser in the BREEAM the one in the LEED is more extensive and includes the management of the project. The first step in obtaining LEED certification is the registration of the building in the green building certification Institute (GBCI). Institute of certification of green buildings executes the program accreditation as a LEED Green Associates (LEED GA) and LEED Accredited Professionals (LEED AP).

There is also a difference in how the scores for LEED are calculated. Many criteria are linked to the US dollar (for example, energy efficiency criteria is energy savings), so common currency rating of buildings may be affected in adverse exchange rate fluctuations.

LEED certification also requires the translation of all the drawings in the American metric system (feet instead of meters) which may cause some difficulties as well as additional costs.

Table 3. LEED standards

LEED Design and construction	LEED NC
	LEED FOR SHELL & CORE
	LEED SCHOOLS
	LEED HEALTHCARE
	LEED RETAIL
LEED Interior	LEED FOR COMMERCIAL INTERIORS
	LEED FOR RETAIL INTERIOR
LEED Exploitation of buildings	LEED EB
LEED Homes	LEED for HOMES
LEED Neighborhood development	LEED for Neighborhood Development

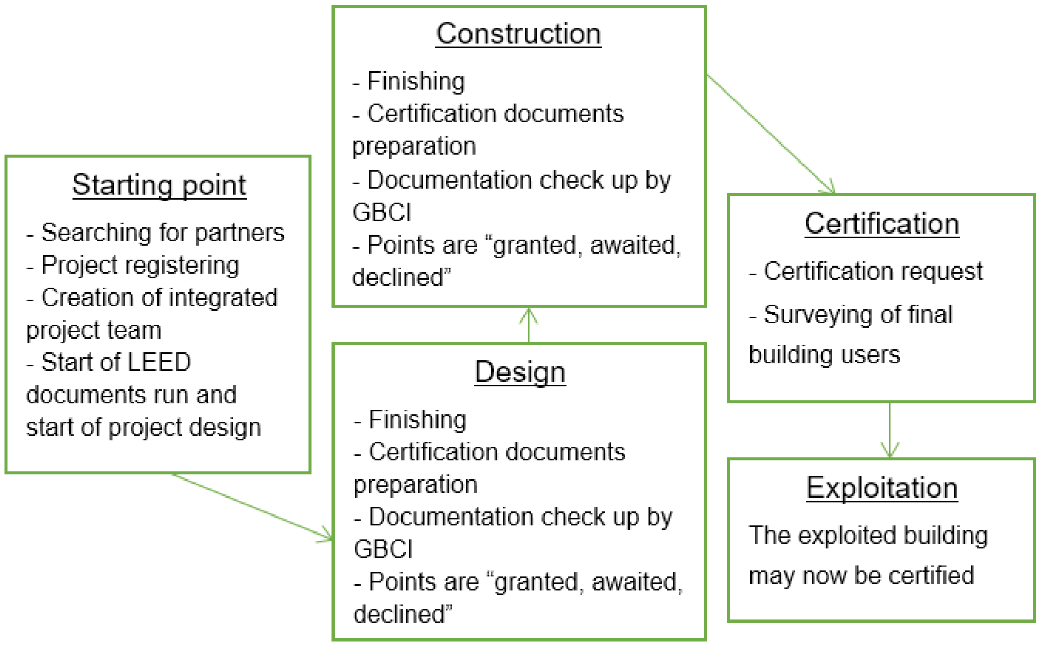

Figure 6. LEED rating process scheme

LEED certification process is automated and can be attend without leaving the country where the project is located. The online system has electronic samples of documents that must be filled for each criterion. LEED Online system also contains rules for the interpretation of scores, which contain answers to technical questions asked by other users. It is important to note down that to get points on the specific parameters it is necessary for the building to be inhabited for some time after construction. When all the documentation is gathered and the construction is complete, a report is transmitted to the Institute for testing and certification. The whole LEED certification process usually takes from one to five years, depending on the type and the requirements for the desired level of certification.

LEED certification by spending accounts usually is about 700-3 400 EUR fee for registering the project, 1 400-6 800 EUR at the time of submission of documents for consideration. Cost of LEED-accredited professional services takes from 27 000 to 90 000 EUR. 9 000 – 54 000 EUR is the cost of adapting the documents as a bonus (Molkhanova 2012). The cost of preparing the documentation is going to be reduced in the process of gaining experience in the implementation of certified projects.

3.3 German ecology certification system DGNB

DGNB®
Deutsche Gesellschaft für Nachhaltiges Bauen e.V.

DGNB certification system was developed by German Board for sustainable construction to be used as a tool for buildings design and quality assurance. At these stages it may help look at the object from different angles. Being clear and friendly rating system DGNB catches all important topic of sustainable construction and awards outstanding structures by categories: bronze, silver and gold.

The final mark is affected by six categories of factors:

- Ecology rating;
- Economy rating;
- Social, cultural and functional features;
- Technology rating;
- Process rating;
- Location rating.

The certificate indicates countable positive changes construction process brought to environment and community.

DBNB main concept is integral planning which at the early stage defines goals of sustainable construction. Therefore, sustainable facilities may be developed based on current technology state and these facilities' quality may be proved by a new certificate.

The whole standard stands on the base of "New office and administrative building construction" rating system which was the first rating system introduced within the standard. After that next systems for totally different building types were presented and integrated for international use. Building types covered by those systems vary from commercial and industrial to educational and residential buildings. Hotel certification systems were launched in 2010, they applied both on building itself and on the interior.

As second generation certification system it is quite flexible. The carcass of the system is the list of questions and sustainable construction criteria, what has diverse value depending on rated structure type. Therefore, every version of the system and thus every building type has its own rating matrix.

Rating criteria have flexible influence on the total building rating depending on their importance. Economy, ecology, technology, social, cultural and functional ratings are equally worth 22.5% of the total mark each. Process rating is worth 10% and location does not affect the final rating but is mentioned there anyway.

Nowadays thirteen types of buildings may be certified by DGNB. Due to its flexibility the standard may be adapted for use under laws of almost any country in the world. There are about 50 requirements in it, and a project must fulfill at least 50% of them to get "bronze" status, at least 65% for "silver' and at least 80% to receive a "golden" certificate.

3.4 Russian ecology certification systems

Green certification systems exist abroad for more than twenty years, meanwhile in Russia they became needed only a little time ago. One of the handicap reasons is the relatively infinite amount of raw material and resources which allowed not to think about their savings. But an increasing trend of energy, construction material, water and so on prices growth forced Russians to think more about lowering energy and material consumption of construction and building maintenance processes. Better life quality helped appear demand on not just spacious, but ecological housing. All mentioned reasons became big enough for an ecological certification to appear, be developed and become spreading in Russia.

3.4.1 Green Construction Board (GCB)

GCB certification systems are designed for various structure types. The standard relies on European experience (lifecycle estimation, typological approach), puts accent on passive energy savings, its criteria are objective and verifiable, Russian Architecture Board eco-stable construction experts are invited for ranking. State Ministry of region development officially supports GCB framework.

3.4.2 Green Standards – ecology ranking center (ECR)

It is applicable for all possible types of buildings, structures and line objects. Green Standards ECR is developed by Ministry of nature resources and ecology of Russia in order to rank Olympic Games facilities (merging with Olympstroy's corporate standard took place). This system stands on LEED and BREEAM certification methods. It is created to minimize construction site's negative environmental effect, to implement energy and material efficient technologies and to push up comfort of living.

Its task is to make sure real estate objects are ecologically safe as much during the construction phase as during the maintenance period; to provide responsible spending of nature resources by all parties and to help customers to make comprehensive estate property choice. Compared to foreign certification systems it does not have typological approach as well as lifecycle rating, many rating criteria are subjects of experts' subjective opinion.

3.4.3 NOSTROY

NOSTROY is a rating system which checks the reliability and quality of a habitat. It is applicable for all types of private and public buildings. It is developed by

Nonprofit Engineering Partnership AVOK for NOSTROY association. Likewise LEED and BREEAM, NOSTROY's main attention is drawn to energy saving and there is no lifecycle evaluation.

3.4.4 GOST R 54964-2012 Rating of conformance to the standards. Ecological requirements for estate objects

GOST is Russian state requirement. This one is valid from the 1st of March 2013. It is based on international ecostandards LEED and BREEAM and Russian Green Standards free choice estate certification system.

GOST R 54964-2012 includes the list of international ISO standards:

1. ISO 15392:2008 Construction sustainability. Main principles.
2. ISO 21929-1:2006 Construction sustainability. Sustainable metrics. Part 1. Basic construction parameters design.
3. ISO 21930:2007 Construction sustainability. Ecology declaration for construction products.
4. ISO 21931-1:2010 Construction sustainability. Basic construction work ecology parameters rating methods. Part 1. Buildings.

The standard sets ecology requirements for construction objects – buildings and structures including house territory. It is applicable for all types of designing, constructing, renovating and ready built estate objects.

It is applied on all stages of design, construction, renovation and maintenance of estate objects as well as at voluntary certification of buildings and their project documents (Appendix 1. Basic ecology criteria for GOST R 54964-201).

3.4.5 Green Zoom

GREEN ZOOM system is the list of practical recommendations designed for the increase of energy efficiency, water efficiency and ecology of civil buildings. It is based on the 4th edition of LEED (LEED v.4, 2014).

The first edition of GREEN ZOOM is meant for civil construction field. The document describes the main criteria of energy-water efficiency and ecology raise of buildings.

GREEN ZOOM certification process has two steps:

1. List of recommendations for designing new projects.

Beside that green technology specialist's manager writes a special project technical specification which includes six chapters:

- Construction site location and transport management there;
- Construction site ecology;
- Energy efficiency and lowering of atmosphere emissions;
- Water efficiency;
- Ecology of construction and interior material, waste management;
- Ecology of indoor area;
- Innovation;
- Region priorities.

Appendix 2 present the GREEN ZOOM certification table. Total of 48 requirements and recommendations. Maximum points score is 90.

2. Energy efficiency and ecology assessment of built and under construction objects.

The certification process is held under authority of RGMD (Russian Guild of Managers and Developers) once the special consulting group is formed.

Table 4. GREEN ZOOM rating

GREEN ZOOM rating	Final result, points
BRONZE	35-44
SILVER	45-57
GOLD	55-69
PLATINUM	≥70

3.4.5.1 Green zoom rating procedure

First of all a work group is formed by the order of the client.

Representatives of investor, client, general contractor, and general designer along with consultants must be in a Work group. Consultants should be experienced at LEED/BREEAM/GREEN ZOOM energy efficiency and sustainable development certification.

Then Work group (WG) is approved by the client. Group's cooperative project recommendations are formalized in a report. A Specific Technical Specification is written based on the report. This Specification describes an advice on increase of energy efficiency, water efficiency and ecology (EWE) of a certain object.

The concept of enhancing facility's EWE is discussed at the first Group meeting. This concept lists all potential opportunities of EWE increase. Social, ecological and economical aims of the project are also determined at this meeting as well as impact on local community, ecology, resource conservation and future area development.

After that, three most important construction cornerstones are analyzed:

1. Construction area:

- Location. Shadowiness, outdoor light, green zones, surface types, availability of resources and raw material;
- Volume-layout design. Cardinal directions and wind rose diagram;
- Temperature resistance of insulated walls and windows, front side glazing coefficient, use of energy efficient windows with different temperature-technical features for each cardinal direction;
- Lighting level. Surfaces reflectivity values.

2. Water demand for:

- Drinking water;
- Territory irrigation;
- Technical needs, technological processes and fire safety;
- Analysis of all possible technical water sources supply – rainwater, retainable grey water, air conditioning condensate;
- Check the possibility of grey water disposal into soil.

3. Heat and electricity demand. Sources of it should be defined (autonomous and/or centralized, renewable).

Consultant studies object's specification and writes a list of suggested actions to be performed based on GREEN ZOOM.

Work group inspects every proposed GREEN ZOOM action with the respect to investments, economy, execution complexity and so on. After that list of actions is approved and formalized.

Special project specification is written by consultant in order to achieve target GREEN ZOOM level (bronze/silver/gold/platinum).

Special project specification is approved by the Customer and the project implementation starts. Consultants help and monitor project group.

The next step is construction expertise of a project. Consultant provides both general and technical support for a project until granted full expertise approval.

Project documentation (PD) with expertise approval becomes the starting point for creating building's energy models: basic energy model and projecting (energy efficient) energy model.

After energy modelling is done customer and general designer are granted GREEN ZOOM project certificate, object's marketing database starts being formed.

Consultants and commissioning engineers control the process with the respect to special project specification, participate in equipment maintenance work, do instrument audit. Exploitation service is trained after that.

The next 12 months after project finishing consultants are accountable for it, measure real energy efficiency and compare it with projected, do root-cause analysis if needed.

Finally the total points score is calculated and certain GREEN ZOOM certificate is issued.

4 Experience in design of engineering systems in obtaining LEED certification

The data for the thesis was collected during the working as HVAC engineer and designing the engineering services for the office center that got LEED certificate aftermath.

ECO-Status (Figure 7) is an 8-storey business center situated at Ligovsky avenue in St. Petersburg.

Certified in 2015
Standard: LEED.
Level: Gold.
Management Company: Maris.
Developer: First Basis.

Figure 7. ECO Status office center

4.1 Architecture and interior

Building was designed in modern esthetic style. Attention was paid to the appearance of the building as it is situated in the city center (Figure 8). There was disrepair building in the place of the Eco Status.

Eco Status lobby has minimalistic style, there are not any additional detailes such as plants, sofas, chilling zone and etc. It was provided to ensure the maximum amount of free open atrium (Figure 9).

The interior has open space style. Hidden rails situated in the floor to install partitions. Thus, any office space can be changed by means of mobile partitions, what have a stiffness and good soundproofing (Figure 10). What is more, there are 3 terraces with access for all office center workers.

There are griliato style ceilings in the public areas, while offices do not have ceilings, so the engineering services are not hidden. It is designed in order to avoid dust on the ceilings which influence bad on human health.

The floor has good soundproofing as acoustic screed was used.

Figure 8. Facade of ECO Status building

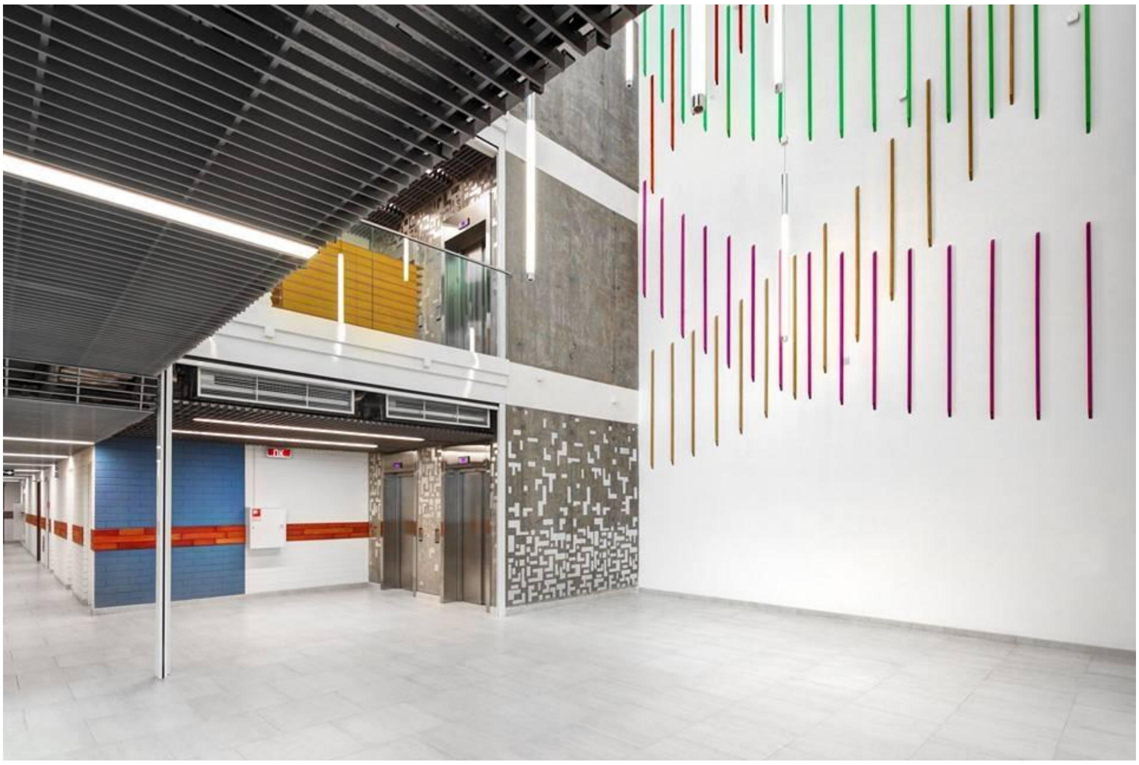

Figure 9. Lobby in ECO Status building

Figure 10. Office in ECO Status building

4.2 Green technologies of Eco Status building

In order to save electricity such technological solutions were provided as solar panels located on the roof (with wattage 2,4 kWh). Wind turbine Aeolos system that generates additional electricity (0,6 kWh). Energy efficient lighting with total consumption 21 kWh (during the simultaneous operation of all lamps). LED-lighting and motion sensors are installed throughout the building.

Energy-saving windows: two-chamber, with low-emissivity glass, reducing heat loss by 30% compared with ordinary glass. Such efficiency was achieved by the combination the glass coating, and the gas mixture filling the space between the panes. Glazing which is applied in the building has the following specifications: thermal conductivity coefficient Ug = 0,8 W / m^{2}K, indicators of light transmission LT = 64% and a solar light transmittance level SF = 43%.

According to SP 50.13330.2012 during the walling calculation the requirements (1) and (2) should be satisfied.

$$\mathrm{R}^{\mathrm{wall}} \geq \mathrm{R}_0^{\mathrm{req}} \ (1)$$

$$\mathrm{R}^{\mathrm{wall}} \geq \mathrm{R}_0^{\mathrm{pr}} \ (2)$$

$R^{wall}, m^2 \cdot °C/W$– R-value of the walling.

$R_0^{req}, m^2 \cdot °C/W$ – R-value with taking into account the sanitary-hygienic and comfortable conditions.

$R_0^{pr}, m^2 \cdot °C/W$ – R-value taking into account the energy saving.

According to the project:

$R_0^{req} = 1{,}073\ m^2 \cdot °C/W;$

$R_0^{pr} = 2{,}52\ m^2 \cdot °C/W;$

$R_1^{wall} = 3{,}32\ m^2 \cdot °C/W$ (Figure 11, section 1-1);

$R_2^{wall} = 3{,}09\ m^2 \cdot °C/W$ (Figure 11,section 2-2).

Values R_1^{wall} и R_2^{wall} was calculated with the condition of insulation effective thickness. If the thermal insulation have been selected due to the requirement $R^{wall} \approx R_0^{pr}$,the amount of heat needed would be Q=187 kW. (According to the project the amount of heat for heating Q = 152 kW).

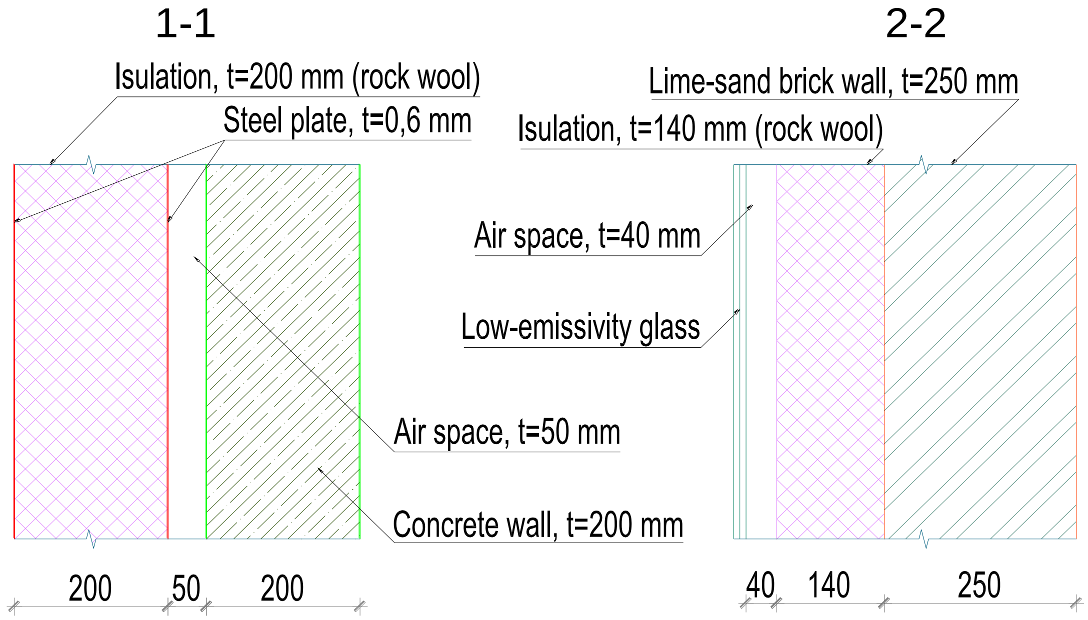

Figure 11. External walls sections.

What is more, such technological solutions were used as rainwater collection. After filtration, the water can be used for technical needs. Elevators with regenerative electricity. During the going down elevator returns electricity that was spent during the lift. Dry urinals and dual-mode toilets for water conservation were used. Separate waste collection. Bicycle and bulk car park. The building has no air conditioning. Cooling takes place by means of ventilation. All air in-take devices contain a carbon dioxide sensor that allows you to control the amount of fresh air in the rooms. There are no false ceilings, what significantly reduces the amount of dust.

4.3 Ventilation system

Figure 12. Ventilation system of ECO Status building

The ventilation of office and public areas is provided by one ventelation machine produced by Swegon (Sweden). WC rooms, storerooms and etc. have local ventilation systems.

The ventilation machine includes humidifier and dryer (for different year periods). It is needed to provide constant relative humidity indoor about 50-60%, the most comfortable conditions for human.

The air speed in the ducts is less than 3.5 m/s. Thus, the maximum noise from the movement of the air flow is 30 dB. For comfortable stay of people indoors, the air speed of the distributing device (cooling beams) does not exceed 1.5 m/s.

To clean the air in the ventilation machine F7 type filters are provided.

The air volume calculated from the condition of 60 m^3/h per person. Due to LEED air volume should be more than 8.5 l/s (30.6 m^3/h), while due to the SNiP 60.13330.2012 it should be minimum 60 m^3/h per person

In order to save energy resources the external walling with higher thermal technical indicators than in SNiP was taken. It has enabled reduction of the required heat energy by 8% during the cold season, as well as weakened the external heat input during the warm period of the year to 3%. Automatic thermostatic valves on the chilled beam were installed, due to that ventilation systems fed only the needed air that has saved 11% of energy. Insulation of pipes, air ducts and heating equipment. It decreased the heat energy lost by 2% during the interaction of pipelines, air ducts and heating equipment with the environment. Recuperates in the ventilation systems were provided. All these actions have reduced the energy consumption of ventilation systems by an average of 23%.

One of the requirement of the LEED, used in the project was providing the sum of all areas of the business center, ventilated mechanically or naturally. The amount should not be less than 90% of the total of its total area. According to the project this value was 92%.

The following LEED requirement was provision of As (m^2) - an area that is served by the entire ventilation system. Due to ASHRAE 62.1, As min = 54%, according to project As=72%.

In addition it is needed to provide the Ps (number of people) - an indicator of the maximum possible number of people in the square, which served the entire ventilation system. Based on the amount of air supplied by the central ventilation system, the Ps was 848 people. Calculation due to ASHRAE 62.1 (with a minimum amount of air supply) Ps was 434 persons.

The last requirement was to provide data on Ras (liters/sec·m2) - an indicator of the outside air, which is required per unit area for each system. According to ASHRAE 62.1, Ras min = 0,3 $l/s\cdot m^2$, according to Ras=0,6 $l/s\cdot m^2$.

As a result, it was found that the ventilation system of the business center satisfy all the LEED requirements.

4.4 Cooling system

In order to increase energy efficiency design the decision was made to use chilled beam instead of air conditioning.

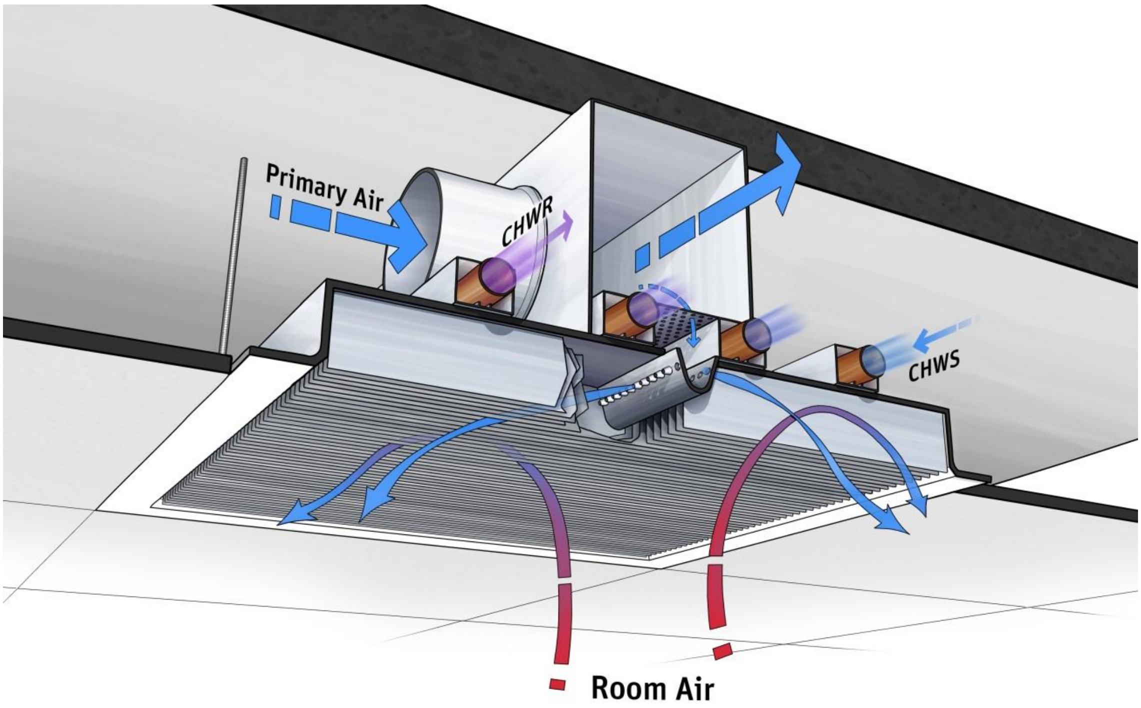

Figure 13. The basic principle of operation of an active chilled beam

In addition, water was used as a coolant instead of freon usual for that propose, as the first is absolutely safe for people.

The cost of the project was reduced to 7 800 000 RUB, and electricity consumption decreased by 21 kW due to the fact that the air distribution unit of the ventilation system and the air cooling device are the same device.

4.5 Heating system

The heating project was completed in accordance with the requirements of energy saving (Paragraph 2 of the Order of the governor of Saint Petersburg №966 from 12.09.2000 "On additional measures for energy efficiency in the design, construction and reconstruction of social facilities and housing and communal services").

To provide the maximum efficiency of heating system, individual heating unit was designed with automatization devices and balancing valves for the accurate system adjustment. It reduced the required amount of thermal energy from the urban heating network by 7%. Besides the system was designed with control and thermostatic valves on each heating branch. Finally, trunk and transit pipelines are in the insulation that saves heat resources.

Due to all mentioned HVAC design decisions the following advantages were reached:

- Consumption heat was reduced by 142 kW (27% of the total amount of initial thermal energy);
- Consumption electricity was reduced by 32 kW (12% of the total amount of initial electricity);
- The cost of the project increased by 12.2 million rubles through the more energy-efficient but expensive equipment. As a result, this amount was paid off in 2 years by reducing heat and electricity consumption.

In 2016, an office center Eco Status got the second place at the Green Awards in the category of office centers (Moscow and St. Petersburg). In the same year the building was certified by GreenZoom and received a gold certificate.

Today EcoStatus is an example to follow among the green buildings in Saint-Petersburg.

5 Conclusion

Green construction standards develop not only construction area, but social environment too. Nowadays green construction is actively used in the USA (LEED), the UK (BREEAM), Germany (NDBG) and more than 40 countries. Nowadays more than 100 000 buildings all over the world are certified.

All the participants of the project: developers, investors, designers, subcontractors, and ofcoures customers get benefits from the certification by green norms. For the tenant it is an opportunity to create a more comfortable environment for employees, increase productivity, save on operational costs, strengthen the reputation in the market. The developer received a marketing advantage, the ability to rapidly sell the building, improve the capitalization rate, attract additional investment and ensure the building with the tenants. Investor primarily reduces the risk of obsolescence of the object of investment and rising of energy prices and improving corporate image. Architects, designers, engineers and contractors involved in the project, which is certified according to international standards, get an independent confirmation of their competence, quality design solutions and competitive advantage. For the state standards of ecological building is an ability to introduce innovative technologies, and support the implementation of environmental legislation.

The cost of certification shall be determined individually for each project. Payments to the certificate authority are about 5 000-10 000 euros. Evaluator service cost dependents on the amount of work (project rating, size, technical complexity. It is quite difficult to calculate the cost rising influenced by certification (sometimes it could be about 200 000 euros). It is not always clear what influence most on the cost increasing and what solutions anyhow would become the part of design regardless of certification. The certification in Russia is on the stage of developing, that is the reason why the cost is so high. Of course in the future, when the enough experience will be get, certification will be more affordable.. It is wirth to mention that most of the building are paying off all the expenses rather quickly, approximately 2-3 years. Save is the average of 50 000 -100 000 euros per year. It is due to the energy efficiency, that means reduction of resources use such as water, electricity and etc..

In Russia the major reasons of the construction of green buildings are the future competitive advantage of the property with the certificate and the desire to prove the quality of the project. While in Russia there is no problem with energy resources, the certification at first will be voluntary, secondly will be too expensive and thirdly only single objects will get certificates. Another certification problem common in Russia is that more than 15% of buildings that applying for the certificates do not reach the final evaluation stage. This is due to the lack of competent management system in the construction process. Customers do not control contractors (designers), begin the process of implementation of green technologies in the project too late and with excessive demands. For example, Ducat Place III (paragraph 3.1.4) registered for certification by the LEED, finally certificated by BREEAM system.

Of course, there are some sites where certification is mandatory (for example Olympics objects in Sochi), but this is the exception rather than the rule. Certification in the Russian market has great potential, and it will grow with the construction of buildings with the highest environmental standards. In addition, this potential is developed at the state level with implementation of Russian green standards, for example GreenZoom.

Now the certificated buildings could be evaluated as 3 of 5 scale. That means that the average grade is good or satisfied by BREEAM system and silver certificate by LEED. As soon as there are buildings with highest grades the process will be on new quality level. Unfortunately, the forcast is that the green construction and further certification would meet a lot of difficulties because of the business culture in Russia, nevertheless it is popular direction among the developers.

Figures

Tables

Charts

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Appendixes

Appendix 1. Basic ecology criteria for GOST R 54964-2012

Category	Criteria
1. Ecology management	1.1 Setting up of ecology management and monitoring. 1.2 Project solutions optimization. 1.3 Qualification requirements.
2. Infrastructure and quality of outdoor area	2.1 Choose of construction site. 2.2 Public transport availability. 2.3 Social and service objects availability. 2.4 Sportsgrounds and playgrounds house territory availability. 2.5 Territory's green area status. 2.6 Landscape irritation. 2.7 Proximity of water objects and visual comfort. 2.8 House territory insulation. 2.9 House territory noise, vibration and infrasound protection. 2.10 House territory illumination and protection from excessive light. 2.11 Ionization and electromagnetic radiation protection. 2.12 Ecological transport availability. 2.13 Building availability for people with disabilities.
3. Quality of architecture and layout	3.1 Quality of architecture image. 3.2 Indoor natural light and insulation sufficiency. 3.3 Indoor green area. 3.4 Effective area sufficiency. 3.5 Space-planning decisions comfort. 3.6 Social and service objects on-site. 3.7 Parking lot sufficiency. 3.8 Optimal form and orientation of the building. 3.9 Excessive ionization protection.
4. Indoor comfort and ecology	4.1 Air-heat comfort. 4.2 Illumination comfort. 4.3 Acoustic comfort. 4.4 Radon protection. 4.5 Engineering maintenance systems control and management. 4.6 Air control and management.
5. Sanitation and waste disposal quality	5.1 Sanitation quality. 5.2 Waste storage and disposal quality. 5.3 Flammable and toxic material storage.

6. Rational water management and drainage management	6.1 Water supply. 6.2 Drainage system. 6.3 Water saving hardware. 6.4 Soil and underground water protection. 6.5 Violation of natural hydrological conditions.
7. Energy efficiency and energy saving	7.1 Lowering of heating and ventilation energy consumption. 7.2 Lowering of hot water supply energy consumption. 7.3 Lowering of electricity consumption. 7.4 Non-reused energy total relative consumption of engineering systems. 7.5 Reused energy consumption. 7.6 Renewable energy consumption. 7.7 Energy infrastructure efficiency increase.
8. Environmental safety during construction, maintenance and disposal of an object	8.1 Lowering construction material ecology impact. 8.2 Lowering of construction waste amount. 8.3 Environment restore work after construction finishing. 8.4 Lowering environment impact during construction, maintenance and disposal of an object.
9. Life safety management	9.1 Backup electricity source. 9.2 Backup heating source. 9.3 Backup water supply source.

Appendix 2. GREEN ZOOM certification table

№	№№	Max points	Requirements
	Introductory	**1**	Creation of a working group. Assessment of the land, architectural planning and engineering design solutions, opportunities identifying to improve energy efficiency, water efficiency and environmental friendliness.
1		1	
	1	**8**	**Built-up area location and transport infrastructure provision**
2	1.1	2	Provision of pedestrian accessibility to various infrastructure
3	1.2	2	Provision of pedestrian accessibility to public transport stops
4	1.3	4	Enabling the use of bicycle transport

	2	**10**	**Environmental sustainability of built-up area**
5	2.1	REQ	Pollution prevention during the construction works
6	2.2	REQ	Evaluation of land
7	2.3	3	Arrangement of the construction site - the protection and recovery of the natural environment
8	2.4	2	Public area organization
9	2.5	2	Rainwater control
10	2.6	2	Local overheating reduction
11	2.7	1	Photopollution reduction
	3	**12**	**Water efficiency**
12	3.1	REQ	Outdoor potable water use reduction
13	3.2	REQ	Indoor potable water use reduction
14	3.3	REQ	Permanent building level water metering
15	3.4	4	Additional outdoor potable water use reduction
16	3.5	6	Additional indoor potable water use reduction
17	3.6	2	Cooler water efficiency
	4	**17**	**Energy efficiency and reduction of harmful emissions into the atmosphere**
18	4.1	REQ	Commissing
19	4.2	REQ	Minimum energy performance
20	4.3	REQ	Building-level energy metering
21	4.4	REQ	The use of refrigerants not destroying the ozone layer
22	4.5	12	Optimization of energy performance
23	4.6	5	Optimize energy performance
	5	**8**	**Environmentally rational choice of building materials and waste management**
24	5.1	REQ	Storage and collection of recyclables
25	5.2	REQ	The use of materials that meet the standards and norms (SNiPs)
26	5.3	2	The use of materials with recycled components
27	5.4	2	Minimizing exported construction site waste. Reuse of construction waste
28	5.5	2	The use of environmentally friendly materials
29	5.6	2	The use of materials from certified wood
	6	**23**	**Indoor environmental**
30	6.1	REQ	Indoor air quality performance due to Russian Federation norms
31	6.2	REQ	Environmental tobacco smoke control
32	6.3	5	Indoor Air Quality Assessment
33	6.4	2	Carrying out mathematical modeling of temperature and velocity fields. Demonstration of indoor comfort declared level achieving
34	6.5	3	The use of materials with low levels of volatile organic compounds
35	6.6	1	Monitoring of indoor air quality during construction
36	6.7	2	Improving the quality of indoor air before building

			commissioning
37	6.8	2	Enabling individual climate control parameters in the rooms
38	6.9	2	Interior lighting requirements
39	6.10	3	Daylight
40	6.11	1	Quality views
41	6.12	2	Acoustic Performance
	7	**7**	**Innovations**
42	7.1	5	Innovations in project
43	7.2	1	Cooperation with Green construction accredited professional
44	7.3	1	Project video review
	8	**4**	**Regional features**
45	8.1	1	South regions of Russian Federation
46	8.2	1	North regions of Russian Federation
47	8.3	1	Dryland regions of Russian Federation
48	8.4	1	Regions rich with geothermal springs